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ABSTRACT

Faced with the current situation of instructional aids that are mediocre and untested, Howard University has revised its undergraduate elementary science teachers course to include instruction on programmed materials. The course is based on the concepts of cybernetics (science of control and communications) and of teaching students the idea of applying the systems approach to the activities of teaching/learning and criterion-referenced testing. Criterion tests with a stimulus-response format and programmed instruction in teaching machines and audiovisual aids were introduced and used in the course. A questionnaire was sent to ex-members of the program to indicate attitudes and use of programmed materials. (JA)

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THE PREPARATION, IMPLEMENTATION AND BEGINNING EVALUATION OF A REVISED UNDERGRADUATE ELEMENTARY SCIENCE TEACHERS COURSE AT HOWARD UNVERSITY

Administrators and teachers all over the Nation are desperately seeking educational aids which will enable them to accomplish educational ends that they acknowledge are not now being accomplished by their personal intervention alone.

Educational publishing firms and other industrial firms have been quick to sense this growing demand for teaching aids and have been equally as quick to flood the market with machines and materials much of which is mediocre in quality and much of which has proved worthless. The purchase of such materials by urban school systems is often done on a haphazard basis and accounts for an unduly large part of the cities education budget. Many of these materials are then foisted off on teachers who are ill equipped to deal with even the best of them because they have not worked with them at the student level and are unwilling to wade through them as teachers. Thus, needed funds are lost buying expensive, sometimes worthless materials while the system suffers. Validated, self instructional systems, when used alone or in a dail access system, could on the other hand, go a long way toward assuring urban school systems of quality instructional materials.

In order to prepare science education students of today to cope with changing forces and events in chis rapidly advancing technological society and properly take advantage of the unique kinds of validated programmed materials being produced today, several factors must be taken into consideration. One of these factors is the idea of "completeness." If programmed materials such as those being produced at Howard University are to be used to any extent, a complete

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cybernetic cycle must be employed. "Cybernetics" is a word first coined by Norbert Weiner in 1947 as a name for the science of control and communication. If science students are to prepare and use self instructional materials effectively then the science of cybernetics must be introduced to them effectively because without its proper utilization the art of communicating is not effectively employed. The advantages of the use of cybernetics are: 1) It diminishes the distinction that is often made between "non living" and "living" systems. Research tends to show that scientific methods can be applied as effectively to biologically animate and social systems as well as to inanimate systems. 2) It dwells heavily on the concept of feedback. This concept is most important for the science student to grasp for there he determines how effective a learning package may be and if revisions or improvements are needed. 3) Cybernetics is also deeply rooted in logic. If instructional packages are to be meaningful then they must be logically constructed for the target population for which they are intended.

Another factor which must be taken into consideration and taught these students is the idea of applying the systems approach to the activities of teaching/learning and criterion referenced testing. A system is composed of components which are interrelated and interdependent in accomplishing a specific objective(s). The systems approach leaves little, if anything, to doubt or second guessing. The "goal" or the " big picture" of what is to be accomplished, is very carefully stated; that is, stated in terms of what the learner will be able to do and in what fields of endeavor. Following the goal the "terminal objective" is stated, by describing what the learner will be able to demonstrate (or other action verb), from whom the instructions are

prescribed, how much of what materials are prescribed, how much time will be allowed the learner, and with what percentage of proficiency the learner is required to accomplish the task. In judging or constructing self instructional materials, we determined the Howard University elementary science student should understand that in learning any task, certain prerequisites are demanded or at least desired. This is based on sound philosophical and psychological theories which support the careful formulation of objectives as underlying or preparing for learning experiences. Gagné lists eight different types of learning, with one preceding the next. The inference is that "chaining" for example, is certainly prerequisite to problem solving. While working with self instructional materials the students were also made aware that a pre-test should be included which measures the criterion, i. e., the objective that the author is attempting to teach. It specifies what the learner will do; under what conditions and at what level of performance.

Interim objectives follow the pre-test and state specifically what the learner will do and with what proficiency and what materials. Specific objectives follow the interim objectives and state exactly how the interim objectives will be attained. The criterion tests follow the specific objectives and utilize the S-R (stimulus-response) performance in order to carefully determine exactly what the learner will be able to do.

This S-R format has the unique advantage of being able to produce changes in learning levels in big city environments. The teacher can very readily relate this to the goals and objectives, and can himself demonstrate the procedure if necessary. The learner can demonstrate the listed procedures with or without the aid of a teacher, provided he is fundamentally prepared and is given the necessary equipment.

The professional staff recognized that student teacher attitudes toward programmed learning and teaching machines would have to be taken into account and possibly redirected. Some teachers feel threatened by the use of teaching machines. Skinner made a major effort to reassure the teacher. He suggested that rather than supplanting teachers, teaching machines would actually liberate them from laborious chores that the machines could accomplish more efficiently. He went on to say that, "The teacher may begin to function, not in lieu of a cheap machine, but through the intellectual, cultural, and emotional contacts of the distinctive sort which testify to her status as a human being." [1] According to Collagan--The terms "programmed instruction" and "teaching machines" still cause some people to react emotionally. Perhaps the impersonal connotation of a machine "teaching" students suggests to many that the days of Orwell's 1984 are indeed upon us! Pessimism of this nature is without foundation. On the other hand, programmed instruction and the teaching machine are equally unlikely to carry us into a kind of Skinnerian utopia where all "drudgery of teaching" is relegated to a box or a book.

Programmed instruction is quite simply a very efficient mode of presenting subject matter. The criticism that programmed instruction will mentally muzzle our students is simply not true. It is no more likely to "brainwash" a student than a biased lecture on socialism by a gifted orator. Komanski's comment is probably the last word with respect to the inessentialness of the teacher.

Another objection frequently mentioned is the fear that these devices threaten to destroy diversity and place students into molds. This is indeed a

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[1] B. F. Skinner, "The Science of Learning and the Art of Teaching," Harvard Educational Review, XXIV (1954), 86-87.

sad commentary and a gross misconception of what programs really do. In reality the only equalizing effect that such instruction will presumably have is the education of all peoples to at least a minimal level, and this is certainly a professed goal of education in a democracy. [2]

Tobias found that elementary and junior high school teachers had significantly more positive attitudes toward terms describing traditional instructional devices, such as workbook and flashcard, than they did toward terms describing programmed media, such as programmed text and programmed instruction. In turn, the programmed terms were rated significantly more favorable than were labels also referring to programmed instruction, but stressing automation, such as teaching machine and automated instruction. It was also found that significant differences existed between essentially syncnymous terms differing only in the degree to which they connoted mechanization or automation. The data strongly suggested that teachers were biased against terms implying automation and indicated the possibility that teachers viewed such media as threatening to their role. [3] Negative attitudes to the media may well mitigate against the success of the materials once they are introduced. [4] Calvin found that if a teacher has negative attitudes, the pupils achievement on the program is lower than in a class where thereis no teacher at all. [5]

The staff recognized at this point that it would be virtually impossible to include all of the listed factors in the science education course so a pre-

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[2] Robert B. Collegan, "The Construction and Evaluation of a Programmed Course in Mathematics Necessary for Success in College Physical Science," unpublished Ph.D dissertation, School of Education, Catholic University of America, 1965.

[3] Sigmond Tobias, "Lack of Knowledge and Fear of Automation as Factors in Teachers' Attitudes Toward Programmed Instruction and Other Media," A. V. Communication Review, Vol. XIV, No. 1 (Spring, 1966), p. 99.

[4] Ibid., p. 108.

[5] A. Calvin, "Preleminary Report on the Programmed Textbook Field Studies," (Chicago: Brittanica Center for Studies in Learning Motivation), April, 1961. (Mimeo)

requisite course was added to the curriculum. This course, titled Educational Technology 007-110, two hours, stated as its objectives the following: 1) To introduce the learner to the principles of Educational Technology. 2) To cite the relationship between the theories of learning and the media of instruction. 3) To demonstrate techniques of using media. 4) To operate standard "audio visual" equipment. 5) The learner will demonstrate his ability to incorporate and use the above by teaching a demonstration lesson to his class at a level of competence acceptable by the instructor.

Lab experiences included: 1) Radio and recordings. 2) Learning lab. 3) Overhead. 4) Slide Projector. 5) 8mm film loop projector. 6) Super 8. 7) Opaque. 8) 16 mm. 9) Visual symbols. 10) Still pictures. 11) 2 x 2 slides. 12) Transparencies. 13) Filmstrips. 14) Opaque materials. 15) Cameras. 16) Film. 17) Television. 18) Videotape. 19) Sound filmstripes. 20) Sound slide sets. 21) Tape workbooks. 22) Teaching machines. 23) Duplicating machines. 24) Bulletin and felt boards.

The elementary science teaching course No. 140-143 lists as its objectives:

1. To introduce pre-service elementary teachers to validated self instructional materials in elementary science, thus acquainting them with these kinds of materials and allowing them to learn the concepts introduced by the materials.

2. Introduce pre-service teachers to the rigours of task analysis and the construction of relevant behavioral objectives in elementary science.

3. Prepare pre-service teachers to use the more sophisticated, as well as commonly found audio visual materials in the classroom setting.

4. Train pre-service teachers to prepare validated self instructional packages which teach important elementary science concepts relevant to urban elementary learners.

A textbook and a science activities book is required of all students and each student is assigned a chapter (of his choice) to teach the class using the techniques he had acquired in Educational Technology 007-110. The instructors serve the students then as resource personnel. Any materials not covered by the students or inadequately covered is taught by the instructors.

Three classes have completed both courses and the participants have either graduated from the University or are currently engaged in completing their final semester in student teaching in large urban school systems.

In order to determine if the training has promise of keeping the student abreast of changes in science education, allow them to constructively evaluate commercial self instructional materials, construct their own materials, validate materials and more effectively teach elementary school science, a 17-item Yes-No questionnaire was prepared. Thirty-six questionnaires were sent out to the target population. The questions and the number of Yes-No respondents to each question are listed below:

1. Did you write one or more programs since you left Howard University? _____Yes _____No

2. Do you use the program you wrote while at Howard in your classroom? _____Yes _____No

3. Do you share programmed materials with other teachers? _____Yes _____No

4. Are other teachers interested in using your program? _____Yes _____No

5. Is administration aware that you have been trained in programming and have programmed materials on site? _____Yes _____No

6. Does administration encourage the preparation and use of programmed materials? _____Yes _____No

7. Do you find the use of programmed materials an effective teaching aid? _____Yes _____No

8. Are other teachers in your school trained to write programs? _____Yes _____No

9. Have you done any in-service teaching about programmed instruction? _____Yes _____No

10. If your school system purchased programmed instructional materials, were you asked to evaluate any of these materials? _____Yes _____No

11. Is your specified level of proficiency consistently attained by your student population? _____Yes _____No

12. Have you revised your program? _____Yes _____No

13. Do you have time to write programs? _____Yes _____No

14. Are you financially rewarded for writing programs by our system? _____Yes _____No

15. Do you fell that you need further training in the science of programming? _____Yes _____No

16. Do you have problems in validating your programs? _____Yes _____No

17. Do you feel threatened by the use of teaching machines and programmed instruction? _____Yes _____No

Results and Conclusions

Of thirty six yes-no questionnaires sent out to ex-members of the program, twenty persons responded. Though the sample is too small to be representative statistically it did furnish the faculty with data which helped to determine if the program should or should not be continued. The tabulated results showed that 4 students have written one or more programs since leaving the University, 12 used the program they wrote during the course in their classrooms, 12 shared their programs with other teachers, 14 indicated that other teachers were interested in using their programs, only 4 indicated that school administrators were aware that they had been trained in programming and had programmed materials on site, 14 indicated that administrators did encourage the preparation and use of programmed materials, all 20 found the use of programmed materials an effective teaching aid, 12 stated that other teachers in their schools were trained to write programs, 4 have done some in-service teaching about P. I., only two have been asked to evaluate P. I. materials purchased by the school system, six indicated that the specified level of proficiency is consistently attained by the student population, 8 have revised their programs, 8 have time to write programs, none of the 20 are rewarded financially by the systems for writing programs, 16 indicated that they needed no futher training in the science of programming, 4 indicated that they had problems in validating their programs, none of the 20 feel threatened by the use of teaching machines or P. I., 19 agreed with the way the class was taught.

The staff has elected to continue the course using the present format, with revisions included as deemed necessary.